U.S. DEPARTMENT OF COMMERCE
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BUREAU OF FISHERIES
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OUTLOOK FOR THE MACKEREL FISHERY, 1934 [1]

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As one of the results of its investigations of the fluctuations in the ackerel fishery, the Bureau of Fisheries has for the last 6 years sued annual forecasts of the probable abundance of the mackerel ist prior to each fishing season.[2] All but two of these predictions ave been within 20 percent of the subsequently realized catch. rom inspection of figure 1 and table 1 it is apparent that the fluctuaons in yield vary much more widely than 20 percent from year to ear. Hence the ascertainment of future prospects, even though ubject at times to errors of as much as 20 percent, constitute a conderable advance in certainty of forthcoming events. Moreover, he experience gained from studying the causes of past inaccuracies as served not only to avoid repetition of error but also to provide a asis for judging the extent to which the future abundance may vary rom the level predicted to be the most probable.

TABLE 1.—*Annual landings of the mackerel fleet 1924 to 1933*

[Figures in thousands of pounds; that is, 000 omitted]

Year	By seiners	By netters		Total	Year	By seiners	By netters		Total
		Spring and summer	Autumn				Spring and summer	Autumn	
24	16,466	1,481	288	18,235	1929	42,234	3,365	567	46,166
25	31,435	2,169	563	34,167	1930	37,924	4,240	993	43,157
26	44,605	1,859	245	46,709	1931	33,324	1,800	1,359	36,483
27	40,006	1,223	584	41,813	1932	43,920	972	1,879	46,771
28	26,816	2,222	1,946	30,984	1933	27,599	968	961	[1] 29,528

Of this quantity about 1,000,000 were discarded owing to lack of market demand.

Last season's forecast illustrates this point. It was predicted that he level of abundance would be such as to yield a catch of about 4,000,000 pounds, but that there were certain elements in the situaon that might cause the abundance to vary from this level sufficiently provide a catch as low as 35,000,000 or as high as 53,500,000 pounds.

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These estimates, of course, were contingent on continuation of the same amount of fishing activity as in the previous season. Actually the level of abundance turned out to be roughly equivalent to the highest estimate so that with the normal amount of fishing, the yield by the purse-seine fleet would have been 53,600,000 pounds. Because of drastic curtailment of fishing activity (see below) the purse-seine catch was reduced to 27,600,000 pounds.

The production of mackerel during recent years has been so large that it could not be absorbed at prices commensurate with the cost of production. In 1933 this difficulty was met by voluntary agreement by mackerel fishermen to limit production in an attempt to bring it into line with the capacity of the market to absorb this product. For 1934 there is now in process of formulation a code under the National Recovery Administration by means of which it is hoped to avoid over-production and consequent distress prices; therefore, it is especially important that the abundance during 1934 be estimated

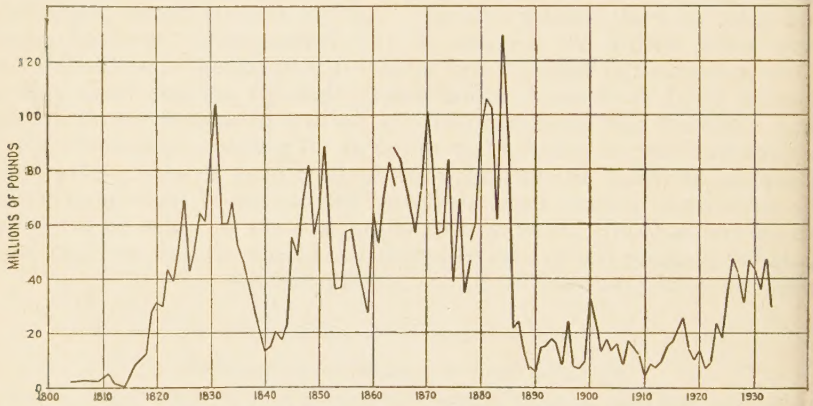

FIGURE 1.—Annual catch of mackerel by American vessels, 1804–1933. Data for 1804 to 1864 consist of total quantity of salt mackerel inspected in Massachusetts; data for 1864 to 1878 consist of the salt mackerel inspected in New England; data for 1878 to 1889 consist of the catch of the salt mackerel fleet of New England; data for 1889 to 1905 consist of the catch of the salt mackerel fleet of New England plus fresh mackerel receipts in Boston; data for 1905 to date consist of the total landings of the American mackerel fleet. All quantities were converted to the basis of fresh round mackerel.

as accurately as possible so that plans may be laid to meet future contingencies adequately. This circular is intended to make available to all concerned, pertinent information as to the prospective abundance of mackerel in 1934.

In previous publications of this series, particularly the one issued in 1933, the causes of fluctuations in abundance and the methods by which future abundance may be estimated have been dealt with in detail. Briefly stated, the changes in abundance are caused primarily by the unequal numbers of mackerel that result from the annual spawnings. For convenience we shall call the mackerel resulting from a season's spawning a "year class" and the mackerel from any particular year, say 1930, the "1930-class." By measuring the abundance of mackerel of each year class as soon as its members are old enough to be caught commercially, and by observing their subsequent annual decline in abundance, it is possible to estimate the relative size of the stock of mackerel present in the sea in any one year and the percentage change that is likely to occur during the following

ar. Such estimates are complicated by the existence of two types year classes which, among other things, differ markedly in their tes of decline. One of them, which we shall term the "transitory pe", declines rapidly after its first appearance in the commercial hery; the other, which we shall call the "persistent type", declines ry gradually. Thus far, our observations cover the course of events 4 year classes of the transitory type and 3 of the persistent type. hese are hardly sufficient in number to provide indications of the ll extent of variability, and to the degree that variability exceeds reviously observed instances; any forecast is likely to fall into error. o indicate the probable extent of the error, as determined from past ariability, our estimates for the season of 1934 include not only the ost probable abundance but also a maximum and minimum robable abundance.

Heretofore the term "abundance" has been used in the general nse of relative plentifulness of the species. In dealing with the ctors affecting the yield of mackerel, it is important not only to nsider the abundance but also the relative accessibility to the mmercial fisherman. To express the combined result of abundance and accessibility the term "availability" will be used. For resent purposes it is measured by the average catch per unit of fort of purse-seine fishing.[3]

Because the changes in yield are governed by different influences the drift gill-net fishery than in the purse-seine fishery, this prediction is confined to the changes of availability as they affect the urse-seine fishery only. Since the latter produces more than 90 ercent of the vessel catch of mackerel, this involves no serious missions.

As a starting point in estimating the probable availability of mackerel in 1934, it is necessary to examine the conditions of 1933. s previously mentioned, there were in force during this season oluntary agreements by the purse seiners regulating the time of shing, the maximum fares to be landed, the minimum prices for sale f fish, and the pooling and dividing of proceeds of sale. The terms of greement changed from time to time. Insofar as they related to shing effort four plans were used as follows:

Plan 1.—In force, with variations, May 21 to June 10. Sailings staggered to spread over 3 days at the beginning of each week. Vessels required to remain in port 24 hours between trips. Limit of 5,000 pounds per trip May 21 to 27, and 20,000 pounds May 28 to une 10.

Plan 2.—In force June 11 to July 22. Fleet divided into two squadons, each fishing on alternate weeks. Limit of 20,000 pounds per week June 11 to July 1, thereafter 2,000 pounds per member of the rew per week. (The latter is equivalent to about 24,000 pounds for he average vessel.) Vessels not securing the limit during the week were allowed to continue fishing during the second week or until he limit was obtained.

Plan 3.—In force July 23 to September 30. Vessels allowed to ish in rotation, 20 at a time July 23 to September 23; 30 at a time September 24 to 30. Limit of 10,000 pounds per trip plus 1,000 pounds per member of the crew. (This is equivalent to about 22,000 pounds for the average vessel.) Vessels to fish at will until limit was obtained, then must await next turn.

[3] For a more complete discussion of this matter the reader is referred to Fishery Circular No. 14.

Plan 4.—In force October 1 to end of season, November 11. Vessels allowed to fish at will but required to remain in port 24 hours between trips. (This is virtually no limitation because the average interval between sailings normally approximates this.) Limit of 20,000 pounds per trip.

In addition to the planned operations, there were several occasions when all vessels were held in port for the remainder of a week following several days of glutted market.

As a consequence of these limitations on the fishing activities it was necessary to take into account the loss of time caused by idle periods in port, loss of fish owing to the letting go and giving away of quantities taken in excess of limits as well as differences in the number of vessels fishing. The results of the computations to correct for these various factors are given in table 2. The total of the figures given in the column headed "Corrected catch in 1933" represents the catch that would have resulted if fishing had been carried on without restriction by the same number of vessels in 1933 as had fished in 1932. This is probably a minimum value because there were some effects of the agreements which could not be fully offset by computation. We believe, however, that it does not differ from the true value by more than 10 percent. For purposes of comparison there is given also the actual catch of 1933 from which it may be seen that the voluntary agreements had the effect of reducing the season's catch about 48 percent.

TABLE 2.—*Comparison of actual catch by purse seiners in 1932 and 1933 with the catch that would have been made in 1933 had there been no change in fishing effort between 1932 and 1933*

Period	Limits on fishing effort	Ratio of 1933 to 1932 catch per unit of fishing effort [1]	Catch, 1932	Corrected catch, 1933 [2]	Actual catch, 1933
			Thousands of pounds	*Thousands of pounds*	*Thousands of pounds*
Apr. 21 to May 20	None	1.329	6,346	8,434	6,10
May 21 to June 10	Plan 1	.821	3,986	3,272	2,64
June 11 to July 22	Plan 2	1.542	6,823	10,521	3,85
July 23 to Sept. 30	Plan 3	1.524	17,824	27,164	11,26
Oct. 1 to Nov. 11	Plan 4	.477	8,941	4,265	3,72
Total			43,920	53,656	27,59

[1] Based on geometric mean ratio of catch per vessel per unit of time of identical vessels fishing during comparable periods in 1933 and 1932.

[2] Quantities that would have been caught in 1933 if the fishing effort had been the same as in 1932.

During 1933 there were three principal categories of mackerel taken by purse seines. Most important of these were the small mackerel, ¾ to 1⅓ pounds each, consisting of members of the 1930 and 1931 classes which comprised 88.5 percent by number and 81.5 percent by weight of the total catch. Second in importance were the medium and large mackerel, mainly 1¾ to 2½ pounds each, consisting mostly of the 1923 class but also including small numbers of the 1928 class and smaller numbers of other year classes. This group represented 10.4 percent by number and 16.8 percent by weight of the catch. The third category consisted of the tinker mackerel, ⅜ to ¾ pounds each (1932 class), which provided only 1.1 percent of the catch by number and 0.7 percent by weight. Since these three categories of

ckerel must provide the mainstay of the coming season's catch, we ll consider separately the contributions to be anticipated from each them.

Small mackerel.—We have just seen that in 1933 the small mackerel ovided the bulk of the catch. They consisted, in about equal proortions, of individuals of the 1930 and the 1931 year classes both of hich have thus far exhibited the characteristics of the persistent type year class. If they continue to behave in accordance with this type, may expect their numbers to decline only 15 percent in 1934. the same time, they will have attained a larger size (estimated to 1.4 pounds in 1934 as compared with an average weight of 1.1 unds in 1933) that will more than offset their decrease in numbers. ie tinkers of last year will graduate into the category of small in 34, but owing to their scarcity, no large contingent need be anticited. We estimate that they will increase the category of small ackerel by only 0.4 percent. Considering all these factors, it apars most probable that we may anticipate an increase of 7 percent the availability of small mackerel. Most of them will be 1¼ to 1½ unds in weight.

However, it has already been pointed out that there is variability in e behavior of year classes even though they be of the same general pe. As far as the persistent type is concerned, it appears that the cline might be as little as 11 percent or as much as 25 percent. rthermore, our estimate of abundance in 1933 was a minimum ure, possibly too low by as much as 10 percent. Taking into acunt these possibilities, we might expect as a maximum an increase 22.8 percent, and as a minimum a decrease of 5.5 percent.

Medium and large mackerel.—During 1933 about 17 percent of the tch by weight consisted of medium and large mackerel. These ere mainly of the 1923 class, hence about 10 years old; the remainder ere mostly of the 1928 class or 5 years old. Having only once eviously observed rates of change of availability of mackerel 5 ars old and not having formerly measured rates of change of ailability of mackerel as old as 10 years, our estimate of their decline the coming year is necessarily more or less of a hazard. However, uring the preceding year this group of mackerel declined 25 percent id in former years the 1923 class, which dominates this group, clined various amounts between 11 and 46 percent. We judge the ost probable rate of decline to be 25 percent and the maximum and inimum rate to be 46 and 11 percent, respectively. There need not anticipated any substantial change in average weight of the ackerel included in this group for it appears that the mortality of der and larger individuals offsets the growth of the younger members that the average weight remains approximately constant.

Tinkers.—As previously mentioned, the tinker-sized mackerel esent during 1933 will have graduated into the class of small by 1934. ich tinkers as may be available during the coming season will be ackerel of the year class of 1933. Since these have not heretofore en of commercial size, we have had no indications as to their preous abundance and cannot forecast their probable availability in 34. Accordingly, it should be understood that the estimates for 34 relate only to mackerel above tinker size. Whatever quantity tinkers may be caught in 1934 will constitute an addition to the ticipated availability of mackerel.

Summary.—Taking into account the percentage increase or de crease expected of each of the groups of mackerel considered in th above paragraphs and also taking into consideration their relativ importance during the coming season, it appears that the most prob able level of availability will be 1 percent above that of 1933. Th highest probable level of availability would represent an increase o 23 percent while the lowest probable level of availability woul represent a decrease of 13 percent. About fourth fifths of the catc will be small mackerel, mainly 1¼ to 1½ pounds in weight while onl one fifth will be of larger sizes, mostly 1¾ to 2½ pounds in weigh Other sizes, excepting possibly tinkers (under 1 pound), will be ver scarce.

To afford a comparison with the total catches of previous years these changes in availability might be translated as follows: With fishing effort equivalent to that employed in 1932 (i.e., unrestricte fishing) the purse-seine catch would be between 46,000,000 an 69,000,000 pounds, most probably 54,000,000 pounds. With fishin effort at the same level as that of 1933 (i.e., with restrictions o activities of the fleet equivalent to those employed last year) th catch would be 24,000,000 to 35,000,000 pounds, most probabl 28,000,000 pounds.

It should be repeated that these figures relate to sizes of macker larger than tinkers (i.e., 1 pound and upward), and only to the purse seine fishery. The drift gill-net fishery is likely to produce a additional 2,000,000 to 4,000,000 pounds of medium and larg mackerel and there may also be a greater or lesser quantity of tinke mackerel.

It is obvious that even the minimum expected level of availabilit is so high that the purse seiners, operating without restriction, woul catch more mackerel than in any year since 1885 (see table 1 an figure 1), and that unless consumer demand becomes much large than it was last season, positive means of regulating production mus be employed if the evils of over-supply are to be avoided.

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